

## **APPENDIX G**

### **RESEARCH/MONITORING ACTIONS PURSUANT TO THE 2004 FCRPS BIOLOGICAL OPINION**

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## **1.0 ESA RESEARCH/MONITORING PURSUANT TO THE BIOLOGICAL OPINION**

Scientific research and monitoring are critical parts of the program to minimize take of ESA-listed anadromous fish species resulting from the operation of mainstem Federal Columbia River Powers System (FCRPS) projects on the Columbia and Snake rivers. These activities are necessary to satisfy elements of this Opinion. In addition, specific terms and conditions related to research and monitoring efforts are proposed for inclusion in the Incidental Take Statement of this Opinion. The required research/monitoring activities will provide data and information necessary to develop annual management strategies to help mitigate hydropower system impacts and to answer important questions related to system operations. Special project operations for required research/monitoring activities that deviate from normal operations described in the Corps' Fish Passage Plan will, however, continue to be coordinated with interested parties through the annual planning process and in subsequent ESA-related coordination with NOAA Fisheries.

The identified scientific research/monitoring activities are only a subset of the activities that will be funded by the Action Agencies (primarily BPA and the Corps). Those agencies are also responsible for complying with Section 7 of the ESA, because they fund activities that may affect threatened or endangered species or designated critical habitat. To streamline the permitting process and avoid delaying critical research, monitoring, and evaluation measures, this Opinion considers the effects of the hydropower activities that would be funded and will fulfill each individual Action Agency's Section 7 consultation requirement.

The amount of mortality and lethal take from these activities is relatively modest in comparison to the overall level in the Incidental Take Statement of the Opinion. The 2003 research, monitoring, and evaluation (RM&E) take tables that follow illustrate that the most recent actual reported take is a low percentage of mortality and lethal take. The percentage of mortality attributable to this take will change from year to year, depending upon the research need for the year, annual run size of the ESUs, and the development of less intrusive equipment. The specific research activities are not included in this Opinion, because they are not all well enough defined to identify the proposed plans, timing, and methods and, from that, the estimated levels of take into the future. Because the study plans are developed each year in accordance with this Opinion, NOAA Fisheries will annually use regional coordination through the Corps anadromous fish evaluation program (AFEP) process, BPA Fish and Wildlife Program review, and independent NOAA Fisheries review of each RM&E proposal for hydro activities before implementation.

## **2.0 ANNUAL RM&E REVIEW PROCESS**

As is currently the case, most hydrosystem research and monitoring activities will continue to be coordinated through the Corps AFEP, BPA Fish and Wildlife Program review, and NOAA Fisheries Hydropower Division processes, which provide for scientific and regional Comanager review and collaboration. It is anticipated that many of the ongoing research activities that are listed in Appendix H of the 2000 Biological Opinion, along with new proposals adopted by the AFEP and NOAA Fisheries' processes in 2004, will continue in the near term to be prioritized for funding and authorization. In order to make the research and monitoring activities responsive to emerging information needs, this biological opinion does not specifically designate what hydrosystem research and monitoring activities must be funded to implement the Opinion's research and monitoring needs. That decision will be made through the procedures described below on an annual basis.

As mentioned, the Corps and BPA programs will continue to develop hydrosystem research and monitoring activities that are then prioritized for funding through the System Configuration Team or BPA's regional process. In 2004, NOAA Fisheries initiated a procedure to identify and approve new research proposals that were important to implement the 2000 Biological Opinion but were not specifically identified in the list of projects in Appendix H of that biological opinion. After these proposals were reviewed through AFEP, NOAA Fisheries made its own determination whether the research was covered under the Incidental Take Statement of the 2000 Biological Opinion and whether the research was warranted and would meet the hydrosystem research needs specified in that Opinion.

Each research determination placed specific terms and conditions, reporting procedures, and limits on take by ESUs for the proposal it reviewed. Modification of the specified conditions was overseen in-season directly by NOAA Fisheries. These determinations were valid for 2004 only; new determinations for each research proposal will be necessary in 2005 and on an annual basis thereafter for their continuation. NOAA Fisheries intends to use the AFEP and BPA processes and determination procedure for all the hydrosystem research and monitoring activities covered by this Opinion beginning in 2005, not only for the new proposals.

Other ongoing hydrosystem research and monitoring activities directly related to this Opinion are now covered under separate ESA Section 10 research permits. Those activities will be modified before the beginning of the 2005 fish passage season to include an annual NOAA Fisheries review and approval similar to the determination procedure above.

For the duration of this Opinion, most research/monitoring activities associated with this Opinion will not be determined in sufficient detail until annual plans are prepared and approved.

Finally, this review process is intended to be used solely for this Opinion's hydrosystem research and monitoring. Incidental take associated with non-hydro activities, such as habitat or hatchery research, is not covered under this section.

### 3.0 RM&E TAKE TABLES

The following tables show the reported 2003 annual take of ESA-listed juvenile salmonids and the total estimated run, both by ESU, for 2000 FCRPS Biological Opinion RM&E actions.

**Table G.1.** Reported 2003 annual-take of ESA-listed juvenile salmonids: Snake River spring/summer chinook salmon. The total estimated run for Snake River spring/summer chinook in 2003 was 2,459,883 naturally produced (wild) fish and 1,747,310 hatchery fish.

Research Action	Location	Handle #s in 2003		Tag #s in 2003		Mortality #s in 2003	
		Art-Prop	Nat-Prod	Art-Prop	Nat-Prod	handle	tag
946	EST		72,911			2	
946	EST	68,460				1	
1036	HCY		139			0	
1036	HCY	197				0	
1130	JDA			72			0
1240	LGR	52 (not designate whether art or nat)				1	
1240	LGR			175 (not designate whether art or nat)			3
1240	LGR						7*
1241	JDA				1		0
1242	LGR	32,440				13	
1242	LGR		4,603				11
1242	LGR				49,983		223
1243	LMN	226				28	
1243	LMN			501			27
1243	LMN		705			0	
1243	IHR	253		2,132			27 for both
1243	LGO	2,160		2,610			68 for both
1243	LGO		5,760			8	
1244	MCN		94			1	
1244	MCN	63				1	
1291	JDA		135			0	
1291	JDA				4		0
1291	JDA	52				0	
1291	JDA		85				2
2006	TDA	3				0	

\* = euthanized

Note: Research Action 946 in all tables used a pair-trawl and no fish were physically handled or intentionally disturbed

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.2.** Reported 2003 annual-take of ESA-listed juvenile salmonids: SR fall chinook salmon. The total estimated run for Snake River fall chinook in 2003 was 1,051,615 fish.

Research Action	Location	Handle #s in 2003	Tag #s in 2003	Mortality		Lethal
				handle	Tag	
946	EST	8,171		0		
1036	HCY	17,011		0		
1036	HCY		5,259		1	
1036	LGR	113		2		
1036	LGR		128		6	
1241	JDA		1		0	
1241	MCN	1		1		
1241	MCN		2		1	
1241	MCN					1
1242	LGR	2,651		9		
1243	LGO	9		0		
1243	IHR	6,942	10,450		88	
1244	MCN	33		0		
1291	JDA	128		0		
1291	JDA		13		0	

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.3.** Reported 2003 annual-take of ESA-listed juvenile salmonids: SR steelhead. The total estimated run for Snake River steelhead in 2003 was 1,456,575 fish.

Research Action	Location	Handle #s in 2003	Tag #s in 2003	Mortality	
				handle	tag
946	EST	47,790		2	
1036	HCY	18		0	
1240	LGR	88		0	
1240	LGR		595		1
1242	LGR	4,762		7	
1242	LGR		34,604		107
1243	LGO	846		1	
1243	LMN	212		0	
1244	MCN	32		0	
1291	JDA	62		0	
1291	JDA		7		0

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.4.** Reported 2003 annual-take of ESA-listed juvenile salmonids: UCR spring chinook salmon and UCR steelhead. The total estimated run for UCR spring chinook in 2003 was 4,644,790 naturally produced fish and 1,262,700 hatchery fish. The total estimated run for UCR steelhead in 2003 was 670,171 fish.

Research Action	Location	Handle #s in 2003		Tag		Mortality	
		Art- Prop	Nat- Prod	Art- Prop	Nat- Prod	handle	tag
UCR Spring Chinook Salmon							
946	EST		6,730			2	
946	EST	22,994				1	
1130	JDA			482			0
1241	JDA				3		0
1244	MCN		531			7	
1244	MCN	113				2	
1291	JDA		601			0	
1291	JDA				20		0
1291	JDA	124				0	
1291	JDA			115			5
UCR Steelhead							
946	EST		11,487				0
946	EST	20,897				1	
1244	MCN	174				0	
1244	MCN		30			0	
1291	JDA		142			0	
1291	JDA				17		0
1291	JDA	408				0	
1291	JDA			11			0

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.5.** Reported 2003 annual-take of ESA-listed juvenile salmonids: MCR steelhead, UWR chinook salmon, and UWR steelhead. The total estimated run for MCR steelhead/summer in 2003 was 362,707 fish. The total estimated run for UWR steelhead in 2003 was 183,997 fish.

Research Action	Location	Handle #s	Tag	Mortality	
				handle	Tag
MCR Steelhead					
946	EST	20,137		0	
1244	MCN	13		0	
1299	JDA	120			
1299	JDA		14		0
2006	TDA	1		0	
UWR Chinook Salmon					
946	EST	57,193		2	
UWR Steelhead					
946	EST	6,186		0	

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.6.** Reported 2003 annual-take of ESA-listed juvenile salmonids: LCR chinook salmon, LCR steelhead, and CR chum salmon. The total estimated run for LCR chinook in 2003 was 3,366,862 wild fish and 1,747,310 hatchery fish. The total estimated run for LCR steelhead in 2003 was 227,000 fish. The total estimated run for CR chum in 2003 was 6,000,000 fish.

Research Action	Location	Handle #s	Mortality
<b>LCR Chinook Salmon</b>			
946	EST	1,097,766	4
<b>LCR Steelhead</b>			
946	EST	7,629	0
<b>CR Chum Salmon</b>			
946	EST	199,111	0

Notes for Tables G1-G7 regarding column descriptions, location abbreviations, and research action descriptions follow Table G7 on page G-6.

**Table G.7.** Reported 2003 annual-take of ESA-listed juvenile salmonids: Snake River sockeye salmon. The total estimated run for Snake River sockeye in 2003 was 1,000 fish.

Research Action	Location	Handle #s 2003	2003 Mortality
946	EST	914	0
1242	LGR	2,533	7
1243	LGO	23	0
1243	LMN	14	0
1291	JDA	19	0
1244	MCN	3	0

**Notes for Tables G.1 to G.7:**

Column descriptions

Handle: number of fish captured (or obtained from others), handled, released, or otherwise affected by the research.

Tag: number of fish captured (or obtained from others), handled, tagged/checked, and released

Mortality: number of fish unintentionally killed as a result of handling or tagging

Lethal: number of fish intentionally killed

Location abbreviations

BON: Bonneville Dam	LGO: Little Goose Dam
EST: Columbia River Estuary	LGR: Lower Granite Dam
HCY: Hell's Canyon	LMN: Lower Monumental Dam
IHR: Ice Harbor Dam	MCN: McNary Dam
JDA: John Day Dam	TDA: The Dalles Dam

Research Action Descriptions

Research Action 946: Research to assess the migration timing and relative survival of transported and inriver juvenile chinook salmon migrating volitionally from Bonneville Dam to the mouth of the Columbia River.

Research Action 1036: Research to document the growth, migration timing, survival, and SARs for wild juvenile fall chinook salmon migrating from the Snake River to the mouth of the Columbia River.

Research Action 1130: Research to determine the movement, distribution, and passage behavior of radio-tagged juvenile salmonids at Bonneville, The Dalles, and John Day dams on the lower Columbia River.

Research Action 1193: Research to produce information on migrational characteristics of Columbia and Snake river basin salmon and steelhead. Take is in Table 10.5 only - Smot Monitoring Program is considered an integral part of the Systems operation in this Biological Opinion.

Research Action 1240: Research to provide fishery managers with detailed information on the response of outmigrating juvenile anadromous salmon to operation of a prototype surface bypass structure (removable spillway weir) at Lower Granite Dam.

Research Action 1242: Research to evaluate inriver migration survival versus transportation survival from Lower Granite Dam to below Bonneville Dam.

Research Action 2002: Research to evaluate modifications to the juvenile fish PIT-tag diversion systems at Lower Granite and Little Goose dams on the Snake River.

Research Action 2006: Research designed to evaluate the large-scale predation patterns of northern pikeminnow on juvenile salmonids and American shad (BPA project 9007800). The goal is to investigate large, systemwide (upriver versus downriver) patterns in predation processes, which may have consequences for salmonid survival and management.



The following tables show the reported 2003 annual take of adult salmonids by ESU.

**Table G.8.** Reported 2003 annual-take of adult steelhead. Estimated ESA-listed adult steelhead are in parentheses.

Research Action	Location	Handle	PIT Tag	PIT & Radio Tag	Mortality
		Kelt	Kelt	Kelt	Kelt
Permit 994	LGR	1,838			0
Permit 994	LGR		666		0
Permit 994	LGR			212	0
Permit 994	BON		642 (333 SR, 2 LCR, 13 MCR & 32 UCR)		1
Permit 1244	JDA	47	222	450 (335)	2
Research Action 2006	TDA	(1SR, 1MCR, 8UCR)			0

**Table G.9.** Reported 2003 annual-take of adult tagged spring, summer and fall chinook salmon. Estimated number of ESA-listed fish are in parentheses

Research Action	Location	Spring Chinook	Summer Chinook	Fall Chinook	Mortality
Permit 994	BON	806 (69 UCR)			2
Permit 994	BON		378		1
Permit 994	BON			666 (33)	0
Permit 994	BON	Out of the 1,850 total above, (11 LCR)			

**Notes for Tables 8&9:**

**ESU abbreviations**

LCR: Lower Columbia River  
MCR: Mid-Columbia River  
SR: Snake River basin  
TDA: The Dalles Dam  
UCR: Upper Columbia River

**Location abbreviations**

BON: Bonneville Dam  
JDA: John Day Dam  
LGR: Lower Granite Dam

Permit 994: Research to assess the passage success of migrating adult salmonids at the eight dams and reservoirs on the lower Columbia and Snake rivers, to evaluate specific flow and spill conditions, and to evaluate measures to improve adult fish passage.

Permit 1244: Synthesis of the project abundance, passage, conversion, and return rates from steelhead kelts passing lower Columbia River Dam Research Action 2006: Research designed to evaluate the large-scale predation patterns of northern pikeminnow on juvenile salmonids and American Shad (BPA project 9007800). This 2003 research dealt with smallmouth bass predation.

Permits 994 and 1244 were implemented under Section 10(a)(1)(A) scientific research permits separate from the 2000 FCRPS BiOp

## **4.0 POTENTIAL FUTURE RESEARCH ACTIVITIES**

The following research activities related to the current Opinion and UPA illustrate some of the research that is anticipated over the next several years.

### **4.1 SURVIVAL ESTIMATES**

Research on survival estimates is part of the study, “Survival estimates for the passage of juvenile salmonids through Snake and Columbia River dams and reservoirs” (BPA Project 199302900). Smolts are PIT-tagged at hatcheries and Snake and Columbia River dams to ensure that enough fish of each species of interest are tagged to produce reliable estimates of survival during passage through the hydropower system. Survival estimates are necessary to determine whether the hydropower performance standards in the Opinion are being met each year. The number of fish tagged and the location of tagging vary each year, depending on the number of fish being tagged in other studies. During most years, fish have been PIT-tagged at Lower Granite and McNary dams and Lyons Ferry Hatchery.

### **4.2 TRANSPORT EVALUATIONS**

This research continues evaluations of fish transportation methods and effects as a mitigation tool. It is important, because differences in the responses to transportation by species have been observed, especially for spring/summer and fall chinook salmon and steelhead. The evaluations range from traditional studies comparing smolt-to-adult return rates (SAR) of transported versus non-transported fish, investigations of new transportation techniques (such as ratio of chinook salmon and steelhead, barge/truck loading densities, speed with which fish are transported, etc.), and monitoring of current transportation operations. Tagging generally occurs at Lower Granite Dam but may also occur at hatcheries, holding ponds, acclimation facilities, and other dams, as necessary. Depending on the goals of any particular study, transport groups may be formed at any of the collector dams in the Snake and Columbia rivers. The tagging of naturally produced juveniles may also occur in their natal rivers and streams.

### **4.3 INVESTIGATION OF SNAKE RIVER FALL CHINOOK SALMON LIFE HISTORY**

This research is to help further understand the life history diversity of Snake River fall chinook salmon in order to develop better juvenile migration models, understand over-wintering timing, and define habitat location and use that may help establish habitat restoration priorities. Basic assumptions underlying current models and estimation techniques about the migratory behavior of this group of fish do not always hold true.

In an attempt to better understand fall chinook salmon and create better studies, scale samples from adults that were tagged as juveniles for transport evaluations need to be collected. This collection can only be accomplished at Lower Granite Dam, because it is the only adult trap that samples 100% of the returning adults and has separation-by-code (SbyC) capabilities. All returning adult will be collected using the SbyC system in the adult trap. Scales will be collected

and labeled with the fish's PIT-tag code. The scales will be read by personnel specializing in scale reading. Juvenile migration information will be compared to the scale information.

The advantage of collecting scales from PIT-tagged fish, as opposed to a random collection from untagged fish, is to directly associate known juvenile passage histories through the hydro system with the information (age at ocean entry) obtained by reading the scales. Using scale information without knowing the juvenile passage information allows only vague generalizations based on ocean-entry age. Combining these two datasets (PIT tag and scale information) will provide a better understanding of the juvenile life history of Snake River fall chinook salmon. The information may enable the design of better studies that can impact how the river is managed.

#### **4.4 LIFE CYCLE OF SNAKE RIVER SUBYEARLING CHINOOK SALMON**

This research in Snake River reservoirs would be part of an investigation into the life cycle of Snake River subyearling chinook salmon. A small trawl would be towed through one or more Snake River reservoirs to collect data on subyearling chinook salmon distribution during the late fall and winter months. The work would help to better understand the migration patterns of these fish during times when the detection systems at the Snake River dams are not operational.

#### **4.5 ASSESS THE MIGRATION TIMING AND RELATIVE SURVIVAL OF TRANSPORTED AND IN-RIVER JUVENILE CHINOOK SALMON**

This research involves assessing the migration timing and relative survival of transported and in-river juvenile chinook salmon migrating volitionally from Bonneville Dam to the mouth of the Columbia River. Run-of-river (including ESA-listed juvenile) fish will be observed and handled while they pass through a PIT-tag interrogation net or captured, anesthetized, and examined for PIT tags and the degree of descaling. Then they will be allowed to recover from the anesthetic before being released.

#### **4.6 ADULT PIT-TAG INTERROGATION SYSTEMS**

This research involves adult (and jacks) salmonids that would be tagged at adult fish facilities (AFF) to evaluate the PIT-tag interrogation systems that will be installed into the vertical slots in 2005 and 2006. The plan is to tag salmonids using the same methodology that demonstrated the problem with low PIT-tag detection at Bonneville Dam, especially in the Washington Shore Ladder, that resulted from fish using the weir overflows instead of the orifices. Since only the Washington side will be outfitted with an interrogation system in 2005, the plan is to tag fish only in the fall from populations that were identified as having the lowest detection rates. In 2006, when both sides have been outfitted, a complete evaluation with all of the main salmonid populations will be conducted. With all of the PIT-tag interrogation systems installed into all of the fish ladders at Bonneville Dam, it will be possible to determine if the goal of 95+% detection for the entire dam for all salmonid populations is being met. The schedule will be fall chinook, coho, and steelhead in 2005 and spring, summer, and fall chinook, coho, and steelhead in 2006.

#### **4.7 B2CC PIT-TAG SYSTEM EVALUATION**

This research evaluates the B2CC PIT-tag system. A sample of the main salmonid populations needs to be tagged to determine whether the system is able to detect 60% of the tagged fish transiting the B2CC. Fish of various sizes will need to be detected for this evaluation in 2006 or 2007.

#### **4.8 McNARY DAM FISH CONDITION EVALUATIONS**

This research evaluates the condition of juvenile salmonids, including ESA-listed stocks that pass through the juvenile bypass system at McNary Dam with turbine units operated above the current 1% efficiency level. The research assesses the impact, if any, of prototype bypass system components on injury and descaling rates of juvenile salmonids. Groups of juvenile steelhead, sockeye, and yearling and subyearling chinook salmon will be PIT-tagged and released at different locations to evaluate prototype bypass system components as part of the McNary Dam Turbine Modernization program. While conducting this research, handling, tagging, and incidental mortality of ESA-listed stocks will occur. Bypass system components that may be evaluated over the next several years include: trash racks, extended-length submersible bar screens, vertical barrier screens, and gate-well orifices.

#### **4.9 FISH PASSAGE BEHAVIOR AND SURVIVAL FOR JUVENILE SALMONIDS PASSING LITTLE GOOSE, LOWER MONUMENTAL, AND ICE HARBOR DAMS**

This research evaluates fish passage behavior and survival for radio-tagged juvenile salmonids passing Little Goose, Lower Monumental, and Ice Harbor dams. Evaluations of fish passage behavior include forebay residence time, passage distribution, spill efficiency, spill effectiveness, fish passage efficiency (FPE), fish guidance efficiency (FGE), and tailrace egress. Evaluations of survival include project, dam, and route-specific survival. These studies may include evaluation of passage behavior and survival in conjunction with various project operations or evaluation of removable spillway weirs (RSWs). This research will be used to improve juvenile salmonid passage at the dams.

#### **4.10 JUVENILE SALMONID SURVIVAL BELOW BONNEVILLE DAM AND THROUGH THE COLUMBIA RIVER ESTUARY**

This research provides quantitative assessments of juvenile salmonid survival through the lower Columbia River below Bonneville Dam and through the Columbia River estuary. To accomplish these evaluations, acoustic transmitters will be surgically implanted into run-of-the-river salmonid smolts (including ESA-listed species) captured at Bonneville Dam. Following recovery from anesthesia, tagged fish groups will be held onsite and released below Bonneville Dam after a minimum 24-hour observation period. Subsequent detection of tagged fish on primary and secondary receiver arrays located near the mouth of the Columbia River will provide migration timing information as well as data to estimate survival using the single-release survival model. Comparative survival estimates among stocks, between run/rear types, or by passage history are

expected to inform management decisions concerning the effects of hydropower operations on juvenile salmonid survival and delayed mortality through the lower river.

#### **4.11 FISH TRANSPORTATION EVALUATION**

This research identifies mechanisms contributing to delayed mortality of yearling chinook salmon. Mechanisms contributing to delayed mortality will be investigated.

#### **4.12 DAM SURVIVAL AND EFFICIENCY EVALUATIONS**

The following proposals are all examples of dam survival and efficiency evaluations.

- This research documents migration timing, summer and winter passage, survival, and SARs for wild juvenile fall chinook salmon migrating from the Snake River to the mouth of the Columbia River. Wild fall chinook salmon will be collected along the Hells Canyon Reach and lower Snake River reservoirs and PIT-tagged or radio-tagged. The results will be used to monitor various aspects of fall chinook salmon life history and the effectiveness of summer flow augmentation, summer spill, dam passage structures, and transportation. Specifically, the role summer flow augmentation plays in determining alternative juvenile life histories will be examined. These results, coupled with the extent and location of reservoir over-wintering, the timing of winter dam passage, and subsequent adult contribution, will be used to evaluate assumptions that need to be addressed for transportation studies. The research includes documentation of juvenile life history, migration timing, migratory behavior, survival, dam passage, and transportation.
- This research determines the movement, distribution, and passage behavior of radio-tagged salmonids at Bonneville, The Dalles, and John Day dams on the lower Columbia River. The results will be used to assess fish passage efficiency at John Day and The Dalles dams and to increase bypass efficiency for juvenile salmonids at the dams by designing and positioning prototype surface bypass/collection structures. ESA-listed fish will be acquired from smolt-monitoring program personnel at Bonneville, John Day, and/or McNary dams, implanted with radio transmitters, transported, held for as long as 24 hours, released, and tracked electronically.
- This research provides fishery managers with detailed information on the response of out-migrating juvenile anadromous salmon and steelhead to operation of a prototype surface bypass structure (removable spillway weir) at Lower Granite and Little Goose dams. Juvenile fish for the study will be collected at pre-selected fish traps operated by smolt monitoring program personnel. ESA-listed juvenile fish may also be collected by purse or beach seine in the reservoirs up stream of Lower Granite or Little Goose dams. Fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to release sites, released, and tracked electronically.
- This study supplies fishery managers with data on the timing, passage, and survival of outmigrating juvenile anadromous salmon and steelhead in relation to surface bypass structures (i.e., permanent corner collector or removable spillway weirs) and operations at

John Day, The Dalles, and Bonneville dams. Fish for the study will be collected from the juvenile fish bypass facilities at Bonneville, John Day, and/or McNary dams on the lower Columbia River by smolt monitoring program personnel. The fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to pre-determined release sites, released, and tracked electronically.

- This research uses either acoustic or radio telemetry to provide fishery managers with detailed information on the approach paths, passage, and survival of juvenile salmonids in the forebay of The Dalles Dam. Fish to be tagged may be collected at John Day Dam or transported as necessary from other dams upstream, anesthetized, implanted with acoustic or radio transmitters, allowed to recover, transported to release sites, released, and tracked electronically.
- This research estimates passage and survival of subyearling and yearling chinook salmon and juvenile steelhead at McNary Dam. The estimates from this study will be used to guide dam operations as McNary Dam proceeds with its modernization project. Although the primary collection location of test fish is McNary Dam, test fish may also be collected at John Day Dam and transported upstream to McNary Dam. After fish collection and transportation, fish will be anesthetized, implanted with acoustic or radio transmitters, allowed to recover, transported to release sites both upstream and immediately downstream of McNary Dam, released, and tracked electronically. A small portion of test fish may be euthanized to test the assumption that dead radio-tagged fish will not be mistaken for live radio-tagged fish
- This research uses radio telemetry to estimate the survival of migrant juvenile salmonids through The Dalles and Bonneville dams, as well as providing passage efficiencies of radio-tagged fish at The Dalles Dam. Additionally, research to evaluate the effects of implanting juvenile sockeye salmon with radio transmitters will be conducted. Study fish are collected at fish monitoring facilities at John Day, McNary, and Bonneville dams by smolt-monitoring program personnel.
- This research estimates the survival of subyearling chinook salmon through specific routes at McNary, The Dalles, and Bonneville dams under two different spill operations. The application is to use radio or acoustic telemetry as the primary tools to monitor the behavior, passage, and survival of migrating fish. The study helps evaluate optimum design configuration and survival benefits at the Bonneville Dam Second Powerhouse permanent corner collector and evaluate the effect of spill duration and volume on spillway effectiveness, forebay residence time, and total project and system survival.
- This research determines the effects of radio-tagging subyearling chinook salmon at elevated water temperatures. Study fish will be collected at fish monitoring facilities at selected mainstem dams by smolt-monitoring program personnel.

#### **4.13 SMOLT MONITORING**

This program is to produce information on migrational characteristics of Columbia and Snake river basin salmon and steelhead. The smolt monitoring program produces information on the migrational characteristics of the various salmon and steelhead stocks in the Columbia and Snake River basins and provides management information for implementing flow and spill measures designed to improve fish passage conditions in the mainstem lower Snake and Columbia rivers. The smolt-monitoring sites include tributary monitoring at the Whitebird trap on the Salmon River, the lower Grande Ronde River trap, and the Lewiston (Snake River) trap. The program also includes monitoring at Lower Granite, Little Goose, Lower Monumental, McNary, and John Day dams and at Bonneville Dam First and Second powerhouses.

#### **4.14 SMOLT MONITORING AT ICE HARBOR**

This research monitors the effects of the juvenile fish bypass system at Ice Harbor Dam. Run-of-the-river juvenile fish, a proportion of which are ESA-listed, will be collected from the bypass system at the dam, anesthetized, handled, allowed to recover from the anesthetic, and released. The primary purpose of the sampling is to ascertain fish condition and, thereby, to certify that the bypass system functions correctly. Some adult fish, including ESA-listed adult salmonids are expected to fall back through the juvenile bypass system and be captured and handled in the effort to return them to the river.

#### **4.15 LOWER COLUMBIA RIVER FALL CHINOOK AND CHUM SALMON INFORMATION**

This research is to collect relevant information for lower Columbia River fall chinook and chum salmon so that recommendations can be made for configuration and operation of the FCRPS to protect and/or enhance mainstem spawning populations. Additional studies are planned to characterize stranding of juvenile fish associated with fluctuating stream flows (due to FCRPS operations). The project will provide baseline data to properly manage natural spawning fall chinook and chum salmon in the mainstem Columbia River downstream of McNary Dam. Research will also evaluate the effects of fluctuating flows and power system load on fall chinook and chum salmon and their habitat as outlined in NWPPC (1994).

#### **4.16 FISH PREDATION**

This research is designed to evaluate the large-scale predation patterns of northern pikeminnow on juvenile salmonids and American shad (BPA project 9007800). The goal is to investigate large, system-wide (upriver versus downriver) patterns in predation processes, which may have consequences for salmonid survival and management.

#### **4.17 PASSAGE SUCCESS OF MIGRATING ADULT SALMONIDS**

This research evaluates the passage success of migrating adult salmonids at the eight dams and reservoirs on the lower Columbia and the lower Snake rivers, to evaluate specific flow and spill conditions, and to evaluate measures to improve adult anadromous fish passage. Adult salmonids will be captured at Bonneville, Ice Harbor, and/or Lower Granite dams, anesthetized, fitted with radio transmitters and identifier tags, allowed to recover from the anesthetic, transported, and released. Once the fish are returned to the river, the movement and migration timing of each fish will be recorded at fixed-site and mobile receiver stations as the fish migrate upstream. The primary benefits of the research will be identifying problematic areas in the migration corridor for adult passage and determining the proportion of salmonids that ultimately pass the upstream dams and enter tributaries to spawn, enter hatcheries, are taken in fisheries, or are losses, including the evaluation of spawning success.

#### **4.18 RETURN RATES OF RECONDITIONED KELTS ENCOUNTERED IN THE SYSTEM**

This research assesses the effectiveness of kelt reconditioning strategies by comparing survival and rematuration rates, return rates, migration history, migration timing, and passage behavior of reconditioned fish versus non-reconditioned fish that are either directly transported or allowed to migrate in-river. Based on the results, study recommendations could be developed for a system-wide strategy for the management of kelts encountered at mainstem collector dams in Snake and Columbia rivers. A second promising area of research is coupling short-term reconditioning with transport and release of reconditioned kelts below Bonneville Dam.